Pump Unit for Scroll Drive

The pump unit uses an electric motor to drive a hydraulic pump, the flow from which controls the flow rate to the ROTODIFF (scroll drive) via a control block. The hydraulic operating pressure circuit that is dependent on the bowl drive contains all adjusting components and safety valves.

It is possible to select between three control systems depending on the requirement:

- **VFD-Control**
  automatic, analogue control, electronic with Frequency converter

- **B/C-Control**
  automatic, analogue control, electronic with Proportional throttle valve

- **C-Control**
  automatic, analogue control, hydraulic

Automatic Operation and Regulation

The hydraulic system pressure serves as a direct and accurate control variable. The hydraulic system pressure which is proportional to the scroll torque can be taken as a direct control signal and together
with a suitable control system allows to achieve a very high degree of operational dependability and reliability of the drive.

There are two basic regulation models, digital and analog:

The digital regulation permits a hand adjustable, fixed differential speed, which will "boost" the differential speed to the maximum at some variable preset pressure (scroll torque).

The analog regulation permits a setting of an adjustable differential speed (so-called base differential speed \( \delta_n \)), and a gradual increase in differential speed as pressure (scroll torque) increases. The point at which the differential speed starts increasing, called the regulation point \( P_1 \) is variable, and the rate of increase \( a \) is also adjustable.

With both analog and digital regulation, safety cut-outs are provided in the case of high torque \( P_2 \) and very high torque \( P_3 \). These are signalled by pressure switches (adjustable) and are set-up to cut out the feed pump at \( P_2 \) and cut-off the bowl drive at \( P_3 \).

A pressure relief valve protects the system from overload, preventing damage to the scroll drive by over-torque. This is at a higher value than \( P_3 \), and has the effect of maintaining maximum torque on the scroll so that, as the bowl runs down in speed, the falling "G" forces will allow the scroll to commence rotation again and "unplug" a blocked machine.

**Electronic Regulation Systems**

Depending on the type of electronic unit used the following operation parameters can be displayed or displayed and controlled. It is also possible to process the measured operation parameters with an
interface unit and control the transmitted data with a PLC controller therefore an easy integration through norm fieldbus interfaces into a larger process control system is possible.

Operation parameters as follows:

- Hydraulic pressure in bar (over a pressure sensor)
- Bowl speed in rpm (with speed sensor)
- Differential speed in rpm (with speed sensor)
- Additional measured values (oil temperature, vibration, …)

The benefits of having an electronic control system are manifold:

- Precise control even in the lowest speed range
- Through feedback of the measured differential speed an operation within extremely low differential speed is possible (monitoring of the differential speed through a closed loop control circuit)
- Operating hours of the ROTODIFF, maintenance interval indicator- integration into larger electronic systems
- Utilization of additional regulation parameters is possible (vibration, feed rate, flocculation and so on)
- Integration capability into a superior system

There are two different electronic regulation systems available

**Pump Unit Type VFD**

Mounted on the control block (VFD) is an electronic pressure sensor which transmits the measured system pressure (torque value) to the electronic display, control, or interface unit.

The VFD Drive System consists of a pump unit with a constant displacement pump. The required variation of the oil flow and the resulting differential speed variation is achieved by changing the pump's rotational speed. This is done by a variation of electric motor speed with a frequency converter (VFD). Because the differential speed is proportional to the oil flow, an automatic regulation of the scroll speed is easily obtained.

The scroll torque is sensed hydraulically by the system pressure which is proportional to the scroll torque. Therefore the differential speed can be exactly monitored and automatically controlled with precise accuracy, analogue to the scroll torque and solids loading of the centrifuge. Alternatively the differential speed control signal can be directly taken from the power monitoring of the frequency converter.

Mounted on the ROTODIFF (R) are bowl- and scroll speed sensors, the measured signals are also transmitted to the electronic unit. In addition, the oil temperature and oil levels are recorded at the pump unit.
Mounting on the control block B/C is an electronic pressure sensor which transmits the measured system pressure (torque value) to the electronic display, control, or interface unit. A proportional valve mounted at the pump unit control block B/C controls the oil flow to the scroll drive ROTODIFF. The control current on the proportional throttle valve corresponds directly to the oil flow which is sent to the scroll drive motor.

Mounted on the ROTODIFF are bowl- and scroll speed sensors, the measured signals are also transmitted to the electronic unit. In addition, the oil temperature and oil levels are recorded at the pump unit.
**Hydrostatic Regulation System**

The hydrostatically regulated control block uses the direct feedback of the system pressure respectively scroll torque as a control variable. The automatic regulation characteristics are adjustable through three hydrostatic valves, the emergency functions are set on a manometer pressure switch. In addition, oil temperature and oil level are monitored on the pump unit. Such systems are advantageous for their easy operation and reliability.

**Pump Unit Type C**
\( P_{\text{max}} \)  Pressure cut off point (pressure relief valve)

\( P_3 \)  Pressure cut off point bowl drive (red flag)

\( P_2 \)  Pressure cut off point feed pump (green flag)

\( P_1 \)  Control pressure (boost throttle valve)

?  Pressure stiffness, rate of scroll speed increase (regulation stiffness throttle)

?n  Differential speed (throttle valve)